PUBLIC SERVICE COMMISSION
STATE OF WISCONSIN

Environmental Impacts of Transmission Lines

Introduction

This Overview reviews the environmental issues and concerns raised by the construction of electric transmission facilities. The first part of the Overview provides a general summary of the methods to measure and identify environmental impacts.

The second part of the Overview is an A to Z directory of specific environmental issues and techniques to minimize or mitigate the impacts. The issues include:

- Aesthetics
- Agricultural Lands
- Airports and Airstrips
- Archeological and Historical Sites
- Electric and Magnetic Fields (EMF)
- Endangered/Threatened and Protected Species
- Implantable Medical Devices
- Noise
- Property Owner Impacts
- Radio and Television Reception
- Recreation Areas
- Safety
- Stray Voltage
- Waterways
- Wetlands
- Woodlands

In the final section of this pamphlet, community involvement and the role of the Public Service Commission (PSC) is discussed. PSC regulates transmission line construction so that costs to consumers are minimized, Wisconsin has a safe and reliable electric supply, and environmental and social impacts are limited. This Overview explains the basis for the PSC's environmental analyses of proposed electric transmission line routing and construction. The PSC has other transmission pamphlets reviewing the PSC approval process, easements, underground utilities, and EMF issues. A complete list is included on the back page of this pamphlet or can be viewed on the PSC web site: http://psc.wi.gov.

Measuring and Identifying Environmental Impacts

Quantifying Potential Impacts

The amount of impacts from the construction of a transmission line can be measured in several different ways. Useful methods of quantifying impact are measurements of area (acreage), distance (miles or feet), and the number of poles

In woodlands, where trees must be cleared from a right-of-way (ROW), acreage is a better measure of impact than miles. In other types of areas where ROW clearing is not the primary impact mileage may be a better measure of impact. In agricultural areas, the number of poles crossing a field may be the most significant measure of impact.

Determining the Degree of Potential Impacts

In general the degree of impact of a proposed transmission line is determined by the quality or uniqueness of the environment along the proposed route. The following factors determine the quality of the existing environment:

- The degree of disturbance that already exists
- The uniqueness of the resources
- The threat of future disturbance

The degree of disturbance that already exists in a place is determined by how close the place resembles pre-settlement conditions. For example, an area may have been logged, drained, developed, cultivated, or otherwise substantially altered. Then, the extent of the alteration must be assessed.

Proposed transmission routes are reviewed for species or community types that are uncommon in the region or in the state. Does the resource possess a feature that makes it unique, such as its size or species diversity? Does the resource play a special role in the surrounding landscape?

And finally, will surrounding uses threaten the quality of the resource over time? How is the resource valued by those who own or manage it?

Identifying the Duration of Potential Impacts

There construction of a transmission line involves both long-term and temporary impacts. Long-term impacts can exist as long as the line is in place and include land use restrictions and aesthetic impacts. Temporary impacts occur during construction or at infrequent intervals such as during line repair or ROW maintenance. Temporary impacts during construction can include noise and crop damage.

Choosing Methods to Mitigate Potential Impacts

It may be possible to lessen or "mitigate" potential environmental impacts by adjusting the proposed route, choosing a different type of pole, using different construction methods, or implementing any number of post-construction practices. The PSC can require the transmission construction applicant to use specific techniques to mitigate impacts or require certain mitigation thresholds be met by any reasonable means. Many of these mitigation techniques have become standard utility practices. Common mitigation techniques are shown in Tables 1.

Table 1 Common Mitigation Techniques for Some Vulnerable Resources

Impact	Mitigation
Wetlands	Conduct wetland construction in the winter when the ground may be frozen and use low ground-pressure construction equipment
Soil Erosion	Use erosion control methods recommended by Wisconsin Department of Natural Resources (DNR)
River and Wetland Crossings	Place transmission poles so that the line spans rivers and wetlands. No construction of transmission poles in waterways or banks of waterways.
Mature Trees Located Along Property Boundaries	Share corridors with roads or other utilities to minimize ROW required and cross to other side of road to minimize tree trimming.
Archeological Site in ROW	Use selective pole placement to span archeological site.

Replacing or Upgrading Existing Lines

One way to mitigate impacts during project design is replacing or double-circuiting an existing line rather than building a new line. The environmental advantages of double-circuiting an existing line are:

- Little or no additional ROW clearing, if the new line can be placed in the center of the existing ROW
- Land use patterns may have already adapted to the existing ROW
- Electric and magnetic fields (EMF) may be reduced because new structure designs place line conductors closer together resulting in lower EMF

However, upgrading an existing transmission line from single-circuit to double-circuit can increase the cost by 130 percent or more, depending on the choice of structures and the size of the line. Using an existing transmission line ROW may also not be the best choice when:

- The existing ROW is in a poor location
- New residential areas have been built around the existing line
- Electricity use has grown more in other areas, so using the existing ROW reduces the efficiency of the new line and increases costs
- A wider ROW is needed because the size of the new line is much greater than the existing line

Corridor Sharing

Another common method for mitigating impacts is corridor sharing. Transmission line ROW can be shared with town or county roads, highways, railroads, or natural gas pipelines. Corridor sharing with existing facilities is usually encouraged because it minimizes impacts by:

- Reducing the amount of new ROW required
- Concentrating linear land uses and reducing the number of new corridors
- Creating an incremental, rather than a new impact

In some situations, corridor sharing can have drawbacks. For example, some utility corridors run cross-country for long distances without crossing roadways. Sharing this type of corridor would require additional access roads. If the corridor crosses environmentally sensitive areas, an expanded ROW would have additional impacts to the natural resources of the area. Corridor -sharing with town roads could have aesthetic impacts if the road has a canopy of mature trees and their removal would be required. Landowners who have agreed to an easement for one facility may feel unfairly burdened by the addition of another facility that further limits their rights and use of their property.

Underground Electric Transmission Lines

It is a common practice in residential areas to place low-voltage distribution lines underground. However, placing high-voltage transmission lines underground is less common and can cost two to ten times more than building an overhead line. While this practice may reduce aesthetic and other impacts, it may increase others.

Underground transmission lines can be a reasonable alternative:

- In urban areas where an overhead line can not be installed with appropriate clearances
- When it allows for a shorter route than overhead
- When aesthetic impacts would be significant

Underground transmission lines can have the following disadvantages:

- An increase in soil disturbance
- A complete removal of small trees and brush along the transmission ROW
- Increased construction and repair costs
- Oil-filled underground lines can leak, contaminating surrounding soils

Specific Environmental Issues Associated with Transmission Lines

The following pages describe many of the environmental and social issues vulnerable to impact by the construction and operation of a transmission line. The issues are listed in alphabetical order from A (aesthetics) to W (woodlands).

Aesthetics

The overall aesthetic effect of a transmission line is likely to be negative to most people, especially where proposed lines would cross natural landscapes. The tall steel or wide "H-frame" structures may seem out of proportion and not compatible with agricultural landscapes or wetlands. Landowners who have chosen to bury their electric distribution lines on their property may find transmission lines bordering their property particularly disruptive to scenic views.

Some people however, do not notice transmission lines or do not find them objectionable from an aesthetic perspective. To some, the lines or other utilities may be viewed as part of the infrastructure necessary to sustain our everyday lives and activities. To others, new transmission lines may be viewed in a positive light because it represents economic development.

Aesthetic impacts depend on:

- The physical relationship of the viewer and the transmission line (distance and sight line)
- The activity of the viewer (living in the area, driving through or sightseeing)
- The background, or context, of the transmission line, such as whether the line stands out or blends in

A transmission line can affect aesthetics by:

- Removing a resource, such as clearing fencerows that provide visual relief in a flat landscape
- Degrading the surrounding environment (intruding on the view of a landscape)
- Enhancing a resource (evoking an image of economic strength in a developing business or industrial area)

Mitigation of Aesthetic Impacts

Electric transmission lines can be routed to avoid areas considered scenic. Routes can be chosen that pass through commercial/industrial areas or along land use boundaries.

The form, color, or texture of a line can be modified to minimize aesthetic impacts. The color and construction material of poles can be chosen to blend with or complement the landscape around them. Lines constructed using H-frame poles or on wood rather than steel structures may blend in better with natural surroundings. Stronger conductors can minimize line sag.

ROW management can mitigate aesthetic impacts by planting vegetative screens to block views of the line, leaving the ROW in a natural state at road crossings, creating curved or wavy ROW boundaries, pruning trees to create a feathered effect, and screening and piling brush from the cleared ROW so that it provides wildlife habitat.

In the end, aesthetics are, to great extent, based on individual perceptions. Siting, design, construction, and ROW management can mitigate some of the adverse aesthetic effects of a line. It is in the interest of the applicants and the affected landowners to discuss these measures early in the planning and design process.

Agricultural Land

Transmission lines can affect farm operations and increase costs for the farm operator. Potential impacts depend on the transmission line design and the type of farming. Transmission lines can affect field operations, irrigation, aerial spraying, wind breaks, and future land development. For many transmission lines, state law requires utilities to repair much of the damage that can occur during construction and provide monetary compensation for damages that cannot be easily repaired.

Pole placement in farm fields can:

- Create problems for turning field machinery and maintaining efficient fieldwork patterns
- Create opportunities for weed encroachment
- Compact soils and damage drain tiles
- Result in safety hazards due to pole and guy wire placement
- Hinder or prevent aerial activities by planes or helicopters
- Interfere with moving irrigation equipment
- Hinder future consolidation of farm fields or subdividing land for residential development

Placement of transmission lines along field edges or between fields where windbreaks have been planted can increase erosion of soils, if the windbreaks must be removed.

Mitigation of Agricultural Impacts

The utility should work with agricultural landowners to determine optimal pole heights, pole locations, and other significant land use issues. Problems with pole placement can be addressed by using single-pole structures and placing the line along fence lines or adjacent to roads. If a field must be crossed, larger structures with longer spans can be used to span them. If the structure is not single-pole, it should be oriented with the plowing pattern. Guy wires can be kept outside crop or hay land and have highly visible shield guards.

In areas where aerial spraying and seeding are common, pole height can be minimized and markers on the shield wires above the conductors can be installed.

The potential for soil compaction and erosion by transmission construction and maintenance activities can be lessened. Work in agricultural areas can be performed during the winter months and when soils are not saturated. If compaction has occurred, affected soils can be chisel plowed over successive seasons as needed to break up compacted layers.

The effects of windbreak removal can be mitigated by trimming the windbreak vegetation selectively, replanting lower-growing trees and brushes beneath the line, or creating a new windbreak elsewhere.

USDA Conservation Reserve Program Lands

Some properties in Wisconsin are enrolled in USDA National Resource Conservation Service (NRCS) programs established to preserve wetlands, grasslands, and farmland. These federal easements may have restrictive land uses not consistent with the construction of a transmission line. In these situations, utilities can negotiate with representatives of the NRCS or avoid these properties and find alternative routes for the transmission line.

Airports and Airstrips

Transmission lines are a potential hazard to aircraft during takeoff and landing. To ensure safety, local ordinances and Federal Aviation Administration (FAA) guidelines limit the height of objects in the vicinity of the runways. Utilities can route transmission lines outside of the safety zone, use special low-profile structures, put a portion of the line underground, or place lights or other attention-getting devices on the conductors.

Archeological and Historical Sites

Archeological and historical sites are protected resources. They are important and increasingly rare tools for learning about the past. They may also have religious significance. Transmission line construction and maintenance can damage sites by digging, crushing by heavy equipment, uprooting trees, exposing sites to erosion or the elements, or by making the sites more accessible to vandals. Impacts can occur wherever soils will be disturbed, at pole locations, or where heavy equipment is used.

The Wisconsin Historical Society (WHS) has the primary responsibility for protecting archeological/historical resources. WHS manages a database that contains the records of all known sites. The database is searched

for any sites that might be located along any of the proposed transmission routes. If there is a potential for encountering a site, the PSC must notify the WSC. Archeological surveys might be required in these areas. The results of the surveys are reported to the WHS, and the PSC must ensure that the construction follows all WHS recommendations for avoiding and minimizing impacts to the sites. Route changes are seldom necessary. Judicious transmission pole placement can often be used to span sites and avoid impacts to the sites.

If during construction an archeological site is encountered, the construction at the site is stopped and the WHS and PSC must be notified. Transmission construction applicants must again follow WHS recommendations for managing or minimizing potential impacts to the site.

Electric and Magnetic Fields (EMF)

Health concerns over exposure to EMF are often raised when a new transmission line is proposed. Exposure to electric and magnetic fields caused by transmission lines has been studied since the late 1970s. These fields occur whenever electricity is used. The magnetic field is created when electric current flows through any device including the electric wiring in a home. Every day we are exposed to many common sources of EMF from vacuum cleaners, microwaves, computers, and fluorescent lights.

The research to date has uncovered only weak and inconsistent associations between exposures and human health. To date the research has not been able to establish a cause and effect relationship between exposure to magnetic fields and human disease, nor a plausible biological mechanism by which exposure to EMF could cause disease. The magnetic fields produced by electricity do not have the energy necessary to break chemical bonds and cause DNA mutations.

Reducing EMF Levels of Transmission Lines

Magnetic fields can be measured with a gauss meter. The size of the magnetic field cannot be predicted from the line voltage but is related to the current flow. A 69 kV line can have a higher magnetic field than a 115 kV line. Magnetic fields quickly dissipate with distance from the transmission line.

A common method to reduce EMF is to bring the lines closer together. This causes the fields created by each of the three conductors to interfere with each other and produce a reduced total magnetic field. Magnetic fields generated by double-circuit lines are less than those generated by single-circuit lines because the magnetic fields interact and produce a lower total magnetic field. In addition, double circuit poles are often taller resulting in less of a magnetic field at ground level.

Implantable Medical Devices

Implantable medical devices are becoming increasingly common. Two such devices, pacemakers and implantable cardioverter defibrillators (ICDs), have been associated with problems arising from interference caused by EMF. This is called electromagnetic interference or EMI.

EMI can cause inappropriate triggering of a device or inhibit the device from responding appropriately. Sources of EMI documented by medical personnel include radio-controlled model cars, slot machines, car engines, digital cellular phones, anti-theft security systems, radiation therapy, and high voltage electrical systems and devices. It has been estimated that up to 20 percent of all firings of ICDs are inappropriate, but only a very small percentage of those are caused by external EMI.

Manufacturers' recommended threshold for modulated magnetic fields is 1 gauss which is 5 to 10 times greater than the magnetic field likely to be produced by a high-voltage transmission line. Research shows a wide range of responses for the threshold at which ICDs and pacemakers responded to an external EMI source. The results for each unit depended on the make and model of the device, the patient height, build, and physical orientation with respect to the electric field.

Mitigation of EMI

Transmission lines are only one of a number of external EMI sources. All pacemaker and ICD patients are informed of potential problems associated with exposure to EMI and must adjust their behavior accordingly. Moving away from a source is a standard response to the effects of exposure to EMI. Patients can shield themselves from EMI with a car, a building, or the enclosed cab of a truck.

Endangered/Threatened and Protected Species

Endangered species are species whose continued existence is in jeopardy. Threatened species are likely to become endangered. Species of special concern have some problems related to their abundance or distribution, although more study is required.

The Bureau of Endangered Resources (BER) of the DNR manages the Natural Heritage Inventory (NHI) which lists current and historical sitings of rare plants, animals, and natural communities. The database includes the location and status of these resources.

Construction and maintenance of transmission lines may destroy individual plants and animals or may alter their habitat so that it becomes unsuitable for them. For example, trees used by rare birds for nesting may be cut down or soil erosion may degrade rivers and wetlands that provide required habitat.

Mitigation of Impacts to Protected Species

Impacts to rare and protected species can usually be avoided or minimized by redesigning or relocating the transmission line. When rare plants or animals are known to be present in the project area, the area can be surveyed in order to identify the exact location of species. The PSC has the authority to order transmission construction applicants to conduct surveys and implement mitigation measures. These measures may include the modification of the route, special construction techniques, or limiting construction time to specific seasons.

In some cases, transmission line ROWs can be managed to provide habitat for endangered/threatened resources. An example includes osprey nesting platforms built on top of transmission poles. Close cooperation between the transmission provider, ROW maintenance staff, and the BER is needed to develop an effective management plan.

Noise

Vibrations or humming noise is noticeable most often on older lines. It is usually the result of conductor mounting hardware that has loosened slightly over the years and can be easily repaired by the utility.

The other types of noise are sizzles, crackles, or hissing noises that occur during periods of high humidity and are usually associated with high-voltage transmission lines (345 kV lines). These noises are very weather dependent. They are caused by the ionization of electricity in the moist air near the wires. Though this noise is audible to those very close to the transmission lines, it quickly dissipates with distance and is easily overshadowed by typical background noises.

Property Owner Issues

ROW Easements

Property owner issues are often raised by individuals or communities along proposed transmission line routes. Two common issues are users versus payers and property owner rights versus public good.

There is often a feeling of unfairness between those that use electricity and those that bear the impacts of the facilities required to support that use. The money paid to landowners for ROW easements is meant to compensate them for having a transmission line cross their property. These easement payments are negotiated between the landowner and the utility. Some landowners do not regard the payments as sufficient to truly compensate them for the aesthetic impacts and the loss of full rights to their own land. Also, people who live near the line but not on the ROW may be affected but do not receive an easement payment.

Finally, the policy of corridor sharing favors the placement of new transmission lines within or next to existing infrastructure, causing some landowners to be burdened by multiple easements. These hardships must be balanced against the potential to reduce environmental impacts caused by the development of new transmission corridors.

Property Values

The potential change in property values due to the proximity to a new transmission line has been studied since the 1950s by appraisers, utility consultants, and academic researchers. Data from these studies is often inconclusive and has not been able to provide a basis for specific predictions in other locations for other projects.

A review of the studies indicates that transmission lines have the following effects on property values.

- The estimated reduction in sale price for single-family homes has ranged from 0 to 15 percent.
- Adverse effect on the sale price of smaller properties could be greater than effects on larger properties.
- Other factors, such as schools, jobs, lot size, house size, neighborhood characteristics, and recreational facilities tend to have a greater effect on sale price than the presence of a transmission line.
- Sale prices can increase where the transmission ROW is attractively landscaped or developed for recreation (i.e., hiking, hunting, and snowmobiling).
- Effects on price and value appear to be greatest immediately after a new transmission line is built or an existing ROW is expanded. These effects appear to diminish over time and over generations of property owners.
- Effects on sale price have most often been observed on property crossed by or adjacent to a transmission line, but effects have been observed for properties farther away from a line
- Agricultural values are likely to decrease if the transmission line poles are in a location that inhibits farm operations

Radio and Television Reception

Transmission lines do not usually interfere with normal television and radio reception. In some cases, interference is possible at a location close to the ROW due to weak broadcast signals or poor receiving equipment. If interference occurs because of the transmission line, the electric utility is required to remedy problems so that reception is restored to its original quality.

Recreation Areas

Recreation areas include parks, trails, lakes, or other areas where recreational activities occur. Transmission lines can affect these areas by:

- Repelling potential users of recreational areas who focus on the aesthetics of natural surroundings
- Limiting the location of buildings
- Posing potential safety risks by placement of poles or wires in the path of users, e.g. guy wires over snowmobile trails, or conductors over waterbodies used by sailboats
- Providing paths or better access to previously inaccessible areas for those who snowmobile, ski, bike, hike, or hunt

Some of these effects can be mitigated by locating lines along property edges, using pole designs that blend into the background and reduce aesthetic impacts, or designing recreation facilities to take advantage of cleared ROW.

Safety

Transmission lines must meet the requirements of the Wisconsin State Electric Code which adopts in general, the National Electric Safety Code. The code establishes design and operating standards, and sets minimum distances between wires, poles, the ground, and buildings. Although the code represents the minimum

standards for safety, the electric utility industry's construction standards are generally more stringent than the Wisconsin State Electric Code requirements.

When working near high-voltage transmission lines, electrical contact can occur even if direct physical contact is not made because electricity can arc across an air gap. As a general precaution, no one should be on an object that is taller than 15 to 17 feet under an overhead high-voltage electric line. Individuals with specific concerns about whether it is safe to operate vehicles or farm equipment near transmission lines should contact their electric provider directly.

Fallen Lines

Transmission lines are designed to trip out of service (turn off), if they fall or contact trees. This is not necessarily true of distribution lines. Transmission lines are not likely to fall unless hit by a tornado or truck.

Lightning

Power poles, like trees and other tall objects are more likely to intercept lightning strikes. Transmission lines are therefore usually built with a grounded shield wire at the top of the poles. This protects the transmission line from lightning. Lightning is not more likely to strike houses or cars near the transmission line. Shorter objects under or very near a line may actually receive some protection from lightning.

Induced Voltage

People or animals can receive a shock by touching a metal object located near a transmission line. The shock is similar to that received by touching a television after walking across a carpet. The magnitude and the strength of a charge are directly related to the mass of the ungrounded metal object and its orientation to the transmission line.

Induced current can be prevented or corrected by grounding metal objects near the transmission line. Grounding chains can be installed on tractors. Metal fences can be connected to a simple ground rod with an insulated lead and wire clamp. Electric fences with proper grounding should continue functioning properly even when subject to induced voltage.

Stray Voltage

Causes of Stray Voltage

For the past 20 years, stray voltage has been vigorously studied. Electrical systems are grounded to the earth to ensure safety and reliability as required by the National Electric Safety Code. Because of this, some current flows through the earth at each point where the electrical system is grounded and a small voltage develops. This voltage is called neutral-to-earth voltage (NEV). When NEV is measured between two objects that may be simultaneously contacted by an animal, it is considered stray voltage.

Low levels of AC voltage on the grounded conductors of a farm wiring system are a normal and unavoidable consequence of operating electrical farm equipment. Stray voltage often is not noticeable to humans, but may be felt by an animal. For example, a dairy cow may feel a small electric shock when it makes contact with an energized water trough.

Stray Voltage Impacts

Dairy cow behaviors that may indicate the presence of stray voltage include nervousness at milking time, increased defecation or urination during milking, hesitation in approaching waterers or feeders, or eagerness to leave the barn. A stray voltage problem may be reflected in increased milking time, in uneven milking, and sometimes with decreased milk production. Other non-electrical factors can cause similar symptoms, such as increased mastitis or milk-withholding problems for farms with milking parlors or in barns with milk pipelines.

Measurement of any voltages or current flow in livestock confinement areas can be done using established testing procedures with appropriate equipment.[1] The PSC formed the Wisconsin Rural Electric Power Services program to conduct on-farm investigations and collect data. The PSC ordered the major investor-owned Wisconsin utilities to submit stray voltage findings to the PSC. The Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) provides information to farmers about how to reduce stray voltage if high levels are found on the farm.

Mitigation of Stray Voltage

In 1996, the PSC established a stray voltage "level of concern" of 2 milliamps.[2] The level of concern is a very conservative, below the injury level, below the point where moderate avoidance behavior is likely to occur, and well below where a cow's behavior or milk production would be affected. The PSC and DATCP consider that this level of voltage/current is an amount of electricity where some form of mitigative action should be taken on the farmer's behalf.

If a utility distribution system contributes one milliamp or more to stray voltage on a farm, the utility must take corrective action. If the farm electrical system contributes more than one milliamp, the farmer may want to consider taking corrective measures. Mitigation of any such currents can be achieved through a variety of proven and acceptable means, such as additional grounding or the installation of an equipotential plane, or isolation if necessary.

Waterways

Waterways in the form of creeks, streams, rivers, and lakes are abundant throughout Wisconsin. Many of these rivers have been designated as special resources that have state, regional, or national significance. Construction and operation of a transmission line across these resources may have both short-term and long-term effects.

The DNR is responsible for permitting stream crossings. For navigable streams or specific protected areas the Army Corps of Engineers and/or the US Fish and Wildlife Service might require additional permits and approvals.

Water quality of waterways can be impacted by soil erosion resulting from driving vehicles through streams, by building temporary bridges, or by clearing of brush from the ROW. Clearing overhanging trees and brush near the waterway can result in increased water temperatures, reducing habitat quality for fish and other aquatic species. Overhead transmission lines across major rivers and streams may have a visual impact for river users and pose a potential collision hazard for waterfowl and other large birds, especially when located in a migratory corridor.

Mitigation of Impacts to Waterways

Transmission line impacts in river environments can be minimized by:

- Designing the line to span the river, avoiding the water.
- Directionally boring the line under the river to eliminate the presence of wires over the river or stream.
- Avoiding the placement of poles in or immediately adjacent to river banks to reduce the potential for soil erosion into the stream.
- Using DNR-approved erosion control methods.
- Placing markers on the top (shield) wire to make the wires more visible to birds if the collision potential is high.
- Using bushes to visually screen the line crossing.
- Maintaining shaded stream areas, where possible.
- Prohibiting construction and maintenance vehicles from driving in waterways.

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[1] PSC White Paper Report: Measurement Protocols – Facts and Misconceptions. This white paper is available on the PSC web site.

[2] PSC docket 05-EI-115, established the "level of concern".

Wetlands

Wetlands occur in many different forms and serve vital functions including storing runoff, regenerating groundwater, filtering sediments and pollutants, and providing habitat for aquatic species and wildlife. The construction and maintenance of transmission lines can damage wetlands in the following ways:

- Heavy machinery can crush wetland vegetation and wetland soils.
- Wetland soils, especially very peaty soils can be easily compacted, increasing runoff, blocking flows, and greatly reducing the wetland's water holding capacity.
- The construction of access roads can change the quantity or direction of water flow, causing permanent damage to wetland soils and vegetation.
- Construction and maintenance equipment that crosses wetlands can stir up sediments, endangering fish and other aquatic life.
- Transmission lines can be collision obstacles for sandhill cranes, waterfowl and other large water birds.
- Clearing forested wetlands can expose the wetland to invasive and shrubby plants, thus removing habitat for species in the forest interior.
- Vehicles and construction equipment can introduce exotic plant species such as purple loosestrife. With few natural controls, these species may out-compete high-quality native vegetation, destroying valuable wildlife habitat.

Any of these activities can impair or limit wetland functions. Organic soils consist of layers of decomposed plant material that formed very slowly. Disturbed wetland soils are not easily repaired. Severe soil disturbances may permanently alter wetland hydrology. A secondary affect of disturbance is the opportunistic spread of invasive weedy species such as purple loosestrife. These invasive species provide little food and habitat for wildlife.

Mitigation of Impacts to Wetlands

Techniques that minimize the potential impacts to wetlands include:

- Avoid placing transmission lines through wetlands.
- Span wetlands wherever possible.
- Limit construction to winter months when soil and water are more likely to be frozen and vegetation is dormant.
- Because many wetlands never freeze, use mats and wide-track vehicles when crossing wetlands.
- Carefully clean construction equipment after working in areas infested by purple loosestrife or other known invasive, exotic species.
- Place markers on the top (shield) wire to make the lines more visible to birds if the collision potential is high.

Woodlands

Wisconsin forests provide recreational opportunities, wildlife and plant habitats, and timber. Building a transmission line through woodlands requires that trees and brush be cleared from the ROW. One mile of 100-foot ROW through a forest results in the loss of approximately 12 acres of trees.

This loss of forested habitat increases the number of common (edge) plants and animals that can encroach into what were the forest interiors. Examples of these species include raccoons, cowbirds, crows, deer, and box elder trees. This encroachment can have impacts on the number, health, and survival of interior forest species, many of which are rare. Interior forest species include songbirds, wolves, and hemlock trees.

Opening the forest floor up to sunlight makes it susceptible to the introduction of exotic plant species which may be inadvertently brought in by construction activities. The disturbance caused by construction can encourage these aggressive, invasive species to proliferate. Examples of problematic exotic species are buckthorn, honeysuckle, and garlic mustard. Exotic species, once introduced, have few local natural controls

on their reproduction and easily spread. Their spread can alter the ecology of a forest as they out-compete native species for sunlight and nutrients, further reducing suitable habitat and food sources for local wildlife.

A transmission line ROW can fragment a larger forest block into smaller tracts. Fragmentation makes interior forest species more vulnerable to predators, parasites, competition from edge species, and catastrophic events. The continued fragmentation of a forest can cause a permanent reduction in species diversity and suitable habitat.

A specific risk to forests is the potential for oak wilt disease. Disturbance in the ROW during transmission line construction or maintenance can contribute to its spread. Red oak, black oak, and Northern pin oak trees are especially susceptible and will often die within one year. The cause of the disease is a fungus which is carried by sap-feeding beetles or spread through common root systems. In the upper Midwest, pruning or removal of oaks should be avoided during late spring and early summer, when the fungus most commonly reproduces.

A cleared ROW increases access into a forest which may lead to trespassing and vandalism. It can also provide recreation opportunities such as access for hunting, hiking, and snowmobiling.

Mitigation of Impacts to Woodlands

Impacts to woodlands can be minimized by:

- Avoiding routes that fragment major forest blocks
- Adjusting pole placement and span length to minimize the need for tree removal and trimming along forest edges
- Allowing tree and shrub species that reach heights of 12 to 15 feet to grow within the ROW
- Following the DNR guidelines for preventing the spread of exotic invasive plant species and diseases such as oak wilt

Community Planning

In prior decades, electric transmission lines were constructed from point A to point B in the most direct manner possible without too much regard for communities, crops, natural resources, or private property issues. As these older lines require improvements, they may now be rerouted to share corridors with roads, and to avoid, where possible, community and natural resource impacts. At the same time, a continued growth in energy usage will require new electric substations and transmission lines to be sited and constructed. New and upgraded electric facilities will impact many communities and many property owners.

To meet future growth, communities often draft plans for sewers, roads, and development districts, but few cities, towns, or counties include transmission lines in their plans. Transmission lines are costly to build and difficult to site. Cities, towns, and counties can help reduce land use conflicts by:

- dedicating a strip of land along existing transmission corridors for potential future ROW expansions
- identifying future potential transmission corridors and substation sites in new developments
- defining set-backs or lot sizes for properties adjacent to transmission lines so that buildings don't constrain future use of the ROW

Being an active participant in the decision-making process will improve the ability of communities to manage future growth and protect their resources.

The Role of the Public Service Commission

The PSC of Wisconsin regulates Wisconsin's utilities. A three-member board (the Commission) is appointed by the governor to make decisions for the agency provided with analysis by a technical staff with a wide range of specialties.

The PSC staff analyzes transmission line applications: (1) to see if they are needed and, (2) to determine the potential impacts. The size and complexity of the proposed project determines the PSC review process. The PSC considers alternative sources of supply and alternative locations or routes, as well as the need,

engineering, economics, safety, reliability, potential for individual hardships, and environmental factors when reviewing a transmission project.

An applicant must receive a Certificate of Pubic Convenience and Necessity (CPCN) from the Commission for transmission line projects that are either:

- 345 kV or greater; or,
- less than 345 kV but greater than or equal to 100 kV, over one mile in length, and needing some new ROW.

The CPCN review process includes a public hearing in the affected project area.

All other transmission line projects must receive a Certificate of Authority (CA) from the Commission, if the project's cost is above a certain percent of the utility's annual revenue. The CA review process does not automatically include a public hearing. However, for those case that do hold hearings, members of the public are encouraged to testify to their views and concerns about the project.

The Commission is responsible for making the final decisions about proposed transmission lines. The Commission decides whether the line will be built, how it is designed, and where it will be located. The Commission reviews all hearing testimony from PSC staff, the applicant, DNR staff, full parties, and members of the public. The three Commissioners meet regularly in "open meetings" to decide cases before them. The public can observe any open meeting. At these open meetings, transmission line projects are approved, denied, or modified. The Commission has the authority to order additional environmental protections or mitigation measures.

The Strategic Energy Assessment

The Strategic Energy Assessment (SEA) is issued biennially by the PSC. It identifies new power plants and transmission projects that are planned to begin construction during the following seven years. The SEA report is issued in July of even-numbered years. Copies of the SEA can be obtained by contacting the PSC. Some of the energy issues addressed in the SEA include:

- Adequacy and reliability of the state's current and future electric energy supply
- Identification of new utility generation and transmission
- Adequacy and reliability of purchased generation capacity and energy
- Adequacy of transmission transfer capability
- Projected demand for electric energy
- Identification of activities to discourage inefficient and excessive power use
- Identification of existing and planned facilities that produce energy using renewable resources
- Potential for economic development, public health and safety, environmental protection, and diversification of supply
- Adequacy of the regional bulk-power market
- Contribution of competition to low-cost electricity

PSC Overview Series

The PSC has prepared other pamphlets for important electric issues that can be viewed on the PSC website: http://psc.wi.gov.

- Common Power Plant Siting Criteria
- Electric Energy Efficiency
- Electric Power Plants
- Electric Transmission Lines
- EMF - Electric & Magnetic Fields
- Nuclear Power Plant Decommissioning and Radioactive Waste Disposal
- Power Plants Approval Process
- Public Hearing Guide, Electric Construction Projects
- Renewable Energy Resources
- Right-of-Way and Easement in Electric Facility Construction
- Transmission Line Approval Process
- Underground Electric Transmission Lines

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6010B July 2004